simultaneously within the limits of error in the observations.

When several observations of such magnetic storms around the equator, obtained by quick-run registerings, are available, as I hope may be the case soon, this important question on simultaneity will be finally determined.

It may be of interest in connection with this to call to mind that, in 1900, quick-run registerings were taken simultaneously in Potsdam and at my observatory at Haldde, near Bossekop. In my work "Expédition Norvégienne de 1899–1900 pour l'étude des aurores boréales," Christiania, 1901, photographs of these registerings are given which show that corresponding small sudden alterations in D were simultaneous within three seconds in Potsdam and Bossekop.

According to my theories of magnetic storms, it might be expected that sudden similar magnetic changes which occur in different parts of the earth arise rather simultaneously. When the sun suddenly sends forth a strong pencil of kathode rays towards the earth, this pencil will, owing to earth-magnetism, be broken up in such a way as to form different partial systems of magnetic impulses—polar and equatorial. The various groups of rays have to travel different way-lengths in space before reaching nearest to the earth, and may arrive at very different earth-regions for the different groups. But the difference in time between these various impulses affecting any particular locality on the earth can scarcely be more than a couple of seconds, while the difference in the intensity of the effects can be very considerable. We know of corresponding phenomena in the case of aurora, as I demonstrate in my first above-cited work.

Christiania, September 29. KR. BIRKELAND.

The Library and the Specialist.

NATURE of August 17 has just come to hand, and I am much pleased to see the article in it (p. 222) on "The Library and the Specialist." The reference there made (not quite accurately) to my own difficulties as a bibliographer and student I gladly pass over: the troubles of an individual are of little moment when they are known to be shared by practically all scientific men.

The general argument in favour of reform is excellently put in the last paragraph of the article, and there is no need to add to it. I ask leave merely to bring things to a practical issue by stating briefly and clearly what steps are necessary to be taken to attain the important object we all have in view.

(1) A hand-list has to be drawn up containing the names of all current mathematical serials. This could be done in a few hours by any competent librarian having a mathematical adviser within reach, the material being all ready to hand in the lists given in the *Jahrbuch*, the *Revue Semestrielle*, and the International Catalogue.

(2) Six copies would have to be made of the said hand-list when finally revised, and one each sent to the librarians of the Mathematical Society, the Royal Society, the British Museum, University College, South Kensington, and the Patent Office, in order that each librarian might indicate which of the serials his library possesses. From all I know of these libraries, I am sure that there is not one of them but would wish to help.

(3) A new list would then have to be made containing the combined details provided by the six, and a copy of this to be furnished to each library.

Any serious obstacle in the way of accomplishing this scheme it is impossible for an outsider to conceive. One of your influential correspondents in 1906 seemed to imply that the librarians would "stand upon the order of their going." Personally, I esteem them too highly to believe this. Any one of three of them might fairly expect the others to follow, the Mathematical Society having a claim to lead because of the special science concerned, the Royal Society because of its outstanding position among scientific bodies, and the British Museum because of its unique position among libraries. Will none of the three risk a rebuff for the work's sake?

I fail even to see that there is a money difficulty in the way. The libraries concerned are constantly being put to greater expense by private individuals. But if money really be wanted, the least we can ask for is to be told the amount. THOS. MUIR.

Cape Town, South Africa, September 5.

I AM glad to be able to assure Dr. Muir and others interested in the matter that steps are about to be taken to carry out the plan he suggests, and to supply each of the six London libraries with the list in its final form. It may even be possible to draw up a more comprehensive scheme, and to publish the list in a periodical readily accessible to mathematicians. If the librarians will give their aid, the minimum for which Dr. Muir appeals will be accomplished before the meeting of the International Congress in 1912.

THE WRITER OF THE ARTICLE.

Two Undescribed Giraffes.

A PIECE of tanned giraffe-skin in my possession, which I intend to present to the British Museum, indicates, apparently, an undescribed race of the netted giraffe (*Giraffa reticulata*) of Somaliland and British East Africa. That species is characterised by the markings taking the form of a coarse network of narrow white lines on a liver-red ground, the dark meshes being large and quadrangular on the neck, but becoming smaller and more irregular in shape on the body. There may be small white spots in the centre of the dark patches, which are otherwise uniformly coloured, even in adult bulls. In the piece of skin referred to above, which is from the forepart of the body, and came from British East Africa—probably the Kenia district—the white lines are rather wider and the dark areas smaller and brownish rufous, with a tinge of blackness, and a distinct blackish streak or star in the centre. For this giraffe, which in a slight degree tends to connect *reticulata* with the eastern forms of *camelopardalis*, the name *G. reticulata nigrescens* will be appropriate.

The second race is typified by a mounted adult bull from north-eastern Rhodesia, the skin and part of the skeleton of which were presented to the British Museum by Mr. H. S. Thornicroft, Native Commissioner of the Petauke district. This giraffe—a member of a single isolated herd—is characterised by the low and conical frontal horn, the grey colour and scattered spotting of the sides of the face, the chestnut-brown forehead, deepening into black on the tips of the horns, the absence of a distinctly stellate pattern in the neck and body spots, which are light brown on a yellowish-fawn ground, and the uniformly tawny colour of the lower portion of the limbs. This giraffe, which I propose to call *G. camelopardalis thornicrofti*, appears to be related to the Kilimanjaro *G. c. tippelskirchi*, but differs by the more compact frontal horn, the brown, in place of grey, forehead, and the uniformly fawn lower part of the legs, the latter being whitish in adult bulls, but fawn and spotted in cows and young bulls. I have to thank the trustees of the British Museum for permission to describe this specimen. R. LYDEKKER.

The Distastefulness of *Anosia plexippus*.

IN "Essays on Evolution," p. 274, 1908, Prof. Poulton directed attention to the instance of mimicry amongst Lepidoptera supplied by the American Danaine, *Anosia plexippus*, otherwise known as *Danaida archippus*, and its mimetic species. It occurred to me, therefore, that it would be interesting to test the distastefulness of this butterfly. This I was enabled to do through the kindness of Mr. F. W. Frowhawk, who at my request sent me a newly emerged female on September 22 of this year.

The following are the results of my experiments. Two Indian shamas (*Cittocincla macrura*) in succession tasted it, but left it alone after one or two pecks. It was then taken by an Indian sibia (*Sibia capistrata*), which quickly dropped it. A red-vented bulbul (*Pycnonotus haemorrhous*) then pounced upon it, with the same result. A ground thrush (*Geocichla cyanonotus*) tried it, but soon left it. A mynah (*Gracula intermedia*) took it, but quickly let it fall. Two South African bustards (*Otis ludwigi*) persevered for a long time, but finally rejected it. A kagu (*Rhinochaetus jubatus*), a kind of rail or crane from New Caledonia, behaved in the same way, shaking his head after each peck. An Australian water-hen (*Tribonyx ventralis*) and

a crow-shrike (*Barita destructor*) pecked it only once, the latter vigorously shaking his head and wiping his beak after the taste. A Cuban mocking-bird (*Mimus orpheus*) and a Brazilian hangnest (*Ostinops viridis*) attempted it, but after a few pecks gave it up. Finally, the mangled remains were eaten with much hesitation by a rufous tinamou (*Rhynchotus rufescens*). Whether the latter would have eaten it, if given the first refusal, it is, of course, impossible to say; but there is no doubt that the other birds found the butterfly highly distasteful. I was particularly impressed by its rejection by the two bustards, which on previous occasions have eaten some of the most unpalatable of British insects (see Proc. Zool. Soc., 1911, pp. 809–68).

The birds used for these experiments belong to tropical American, Asiatic, Australian, and African species, and were purposely selected from a variety of families. *Anosia plexippus* has, I understand, comparatively recently invaded the Old World from the New; and the result of the above-recorded experiments suggests that no serious barrier to its dispersal will be offered by insectivorous birds. If it succeeds in widely distributing itself it may, as a useful model, bring about marked mimetic changes in the Lepidoptera of the districts in which it settles.

The Zoological Society. R. I. POCOCK.

The Arithmetic of Hyperbolic Functions.

THROUGHOUT the books treating of hyperbolic functions, although elaborate series for their determination are given, the possibility of calculating them directly from their definitions, by means of common logarithms, is never suggested, and it would appear, therefore, that the merits of the direct method are insufficiently recognised.

If the hyperbolic functions of a quantity U are required, it is convenient, for purposes of writing and printing, to get rid of the exponential and to write $A=e$. Then $\log_{10} A=0{\cdot}43429448\,U$, and A is thus found at once from a book of common logarithms. The functions can then be calculated by a slide-rule, or by logarithms, in the simple form

$$\cosh U=\tfrac{1}{2}(A+1/A)$$
$$\sinh U=\tfrac{1}{2}(A-1/A);$$

and similarly for tanh U, coth U, sech U, cosech U, and versh U—all in terms of A.

For example, calculate cosh 2 and sinh 2. Here

$$\log_{10} A=0{\cdot}43429448\times 2=0{\cdot}86858896;$$

A is therefore 7·389060, and 1/A is 0·135335. Hence cosh 2 = 3·76220 and sinh 2 = 3·62686

In the more general case the functions of a complex quantity $(U+i\theta)$ are required, and they have consequently to be expanded in terms of cosh U, sinh U, cos θ, and sin θ. So far as cosh U and sinh U are concerned, the direct method by common logarithms is still available, and the result is best dealt with in the form, for example,

$$\sinh(U+i\theta)=\tfrac{1}{2}\{(A-1/A)\cos\theta+i(A+1/A)\sin\theta\}.$$

The only real difficulty then left for the student is in ensuring that cos θ and sin θ are given their proper signs. That is to say, he must be clear regarding how many quadrants are contained in θ, how many degrees there are in θ bevond that number of quadrants, and the proper sign of cos θ and sin θ, respectively, in each quadrant.

In general, as is well known, if the functions are not required to a greater degree of accuracy than 1 in 10,000, it is permissible for all real values of U greater than 5 to write

$$\cosh U=\sinh U=\tfrac{1}{2}A;$$

and the direct method has obvious advantages. For values of U less than 8, Ligowski's excellent tables give sinh U and cosh U, proceeding by increments of 0·01 of U; but for practical purposes these 0·01 steps are too great, and "difference" columns have to be used. Consequently, to find the functions for values of U less than 5, where U is given to three or more places of decimals, it will usually be as quick and as accurate to adopt the direct method as to worry through the irksome arithmetic involved in estimating "differences."

In cable problems it is, as a rule, desirable to retain at least four significant figures for U.

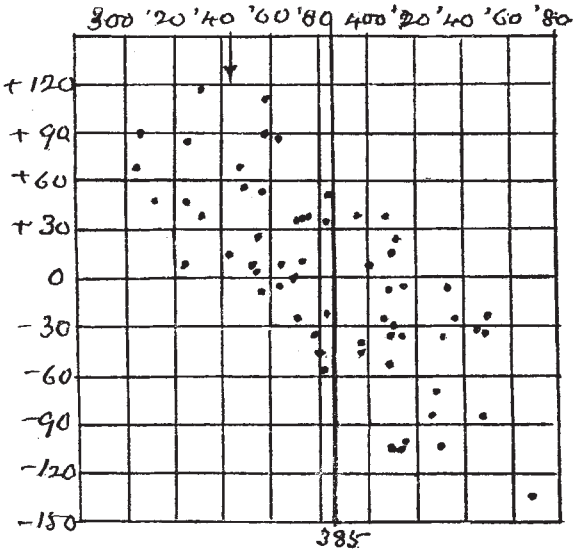
October 3. ROLLO APPLEYARD.

Hot Days in 1911.

BY a "hot day" will here be meant one with 70° or more. There are about seventy-seven of these at Greenwich, on an average, in the year. I propose to show how a method of forecasting recently described would apply to those days in 1911.

The series of annual numbers (1841–1910) is first smoothed with sums of five; then we compare, in a dot-diagram, each sum with the difference between it and the fifth after.

The last comparison before this summer was that between 324 (for 1903) and its difference with 335 (for



Comparison of hot day numbers, Greenwich.

1908), *i.e.* +11. Next we come to 343 (for 1904) and the position of the new dot (for 1909, representing the sum of 1907–11).

Placing an arrow-head at 343 in the horizontal scale, we might fairly expect the new dot to be above the zero line. Suppose, however, to be on the safe side, we say not below −10. Then 343 − 10 = 333. Now the four years 1907–10 yield 243, and 333 − 243 = 90. So that we might say the year 1911 was likely to have at least 90 hot days.

The actual number is 101.

The method may be commended, perhaps, for application to various weather items. ALEX. B. MACDOWALL.

Frequency of Lightning Flashes.

A LETTER on rainless thunderstorms in NATURE of August 31 leads me to ask if any accurate counts have ever been taken of the frequency of lightning flashes.

Watching a severe storm from my bungalow about a year ago, I made an attempt to separate and count the flashes—to the unassisted eye the lightning was as continuous as a flickering arc-lamp.

The only thing I could find to help me was a gramophone; I took its top works off, and on the horizontal disc I put one radial white chalk line. The speed of the disc was adjusted, by trial, exactly to 100 revolutions per minute, and the instrument was placed where the storm-light fell directly on it.

The appearance of the revolving disc was as if irregularly spaced phosphorescent spokes were being shown instantaneously in sections of various sizes in continually changing positions. It was difficult to estimate the number of separate streaks in one revolution, but I finally settled on eight as a fair average during the whole storm—sufficiently exact to show the order of figures being dealt with.

This works out at 800 flashes per minute, or, say, 50,000 an hour. H. O. WELLER.

Jamalpore (Dist. Mymensingh), E. Bengal,
September 19.